BULL. BOT. SURV. INDIA
Vol. 6, No. 1 : pp. 1-6, 1964

NOTES ON INDIAN COMMELINACEAE—IV: CYTO-TAXONOMIC OBSERVATIONS

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ABSTRACT

Chromosome numbers of 29 species and one variety under six genera have been studied of which the chromosome numbers of 9 species and one variety are recorded for the first time. Five species show different chromosome number from previous reports. Further cyto-taxonomic evidence confirm that *Aneilema* (*sensu stricto*) is distinct from *Murdannia.* Majority of the Indian species of *Commelina* and *Cyanotis* (*sensu stricto*) show x=15 and 12 respectively. A new genus name *Amischophacelus* Rolla *et* Kammathy has been proposed for the ochraeflora section of *Cyanotis* (*sensu lato*) on the basis of clear cyto-taxonomic evidence. Aneuploidy, euploidy and intra-specific polyploidy have been observed in different species of *Murdannia.* Both morphological as well as cytological evidence do not suggest the separation of *Aclisia* from *Pollia.* Consideration of the hairy form of *Streptolirion* as *S. volubile* var. *khasiana* seems to be approprate. A new combination is proposed.

In continuation to earlier communications of Kammathy and Rolla [1,2] the present note records the chromosome numbers of species of *Aneilema* R. Br., *Commelina* Linn., *Cyanotis* Don, *Murdannia* Royle, *Pollia* Thunb. and *Streptolirion* Edgew. including some new populations of other species recorded earlier. The materials collected from different parts of India have been worked out following the usual aceto-carmine squash technique. The results are presented in Table I. Out of the 29 species and one variety studied at present, the chromosome numbers of 10 taxa are reported for the first time. In 5 other species the chromosome numbers recorded here differ from previous reports.

The genus *Aneilema* (*sensu stricto*) is represented in India by only six species (cf. Clarke[3] and Brückner[18]) of which the chromosome numbers of three species have so far been worked out. *Aneilema ovalifolium* shows n=14. This number is already reported in different populations of *A. montanum* Wt. (Kammathy & Rolla[2], Shetty and Subramanyam[4]) also, thus indicating the basic number as x=14. However, *A. scaberrimum,* the most widely distributed Indian species of the genus, shows an aneuploid number n=29. In the slides prepared from Nangpoh material by the first author, though several cells in anaphase due to irregular or over pressing show scattered chromosomes numbering about 59, a few cells with distinct 29 bivalents have also been observed in the same slide, thus confirming the uniform number in the widely separated populations of this species. The peculiar appearance of the chromosomes misled Panigrahi & Kammathy[21] and the number 59 has been reported by them as such without further confirmation. The material from the same population cultivated at Poona shows clear 29 bivalents and this confirms with four other populations from South India. The study of the genus with reference to its chromosome number, and other morphological characters further support the separation of several species of *Murdannia* Royle, thus limiting the genus *Aneilema* (*sensu stricto*) under a more natural classification.

Commelina indehiscens as recorded by Barnes with its cleistogamous flowers is a distinct species. *C. alisagarensis* Kumar & Deodikar and *C. persicaraefolia* Wt. which were considered closely related to it are nothing but *C. jacobii* Fischer and not *C. hasskarlii* C.B.Cl. as reported by Rolla[22] for *C. alisagarensis* (types examined). *C. inhediscens* is now found to be well distributed in other parts of Peninsular India, including Ceylon. An interesting species, *C. kotschyi* Hassk. which has been recently collected from the moist, sandy stream beds of Khed taluka and neighbouring areas of Maharastra shows n=15. This African species is now reported for the first time from India (type examined; notes on taxonomy will be published elsewhere). *C. longifolia* which is a good species invariably growing in watery areas and with distinct blue flowers, shows n=45, but Sharma[5] reports 2n=75 for his collections of the species with violet flowers. Rolla *et al*[6] while studying the East Indian material misidentified *C, maculata Edgew.* [=*C. paludosa* Bl. var. *viscida* (Cl.) Rolla *et* Kammathy] as *C. undulata* R. Br. The chromosome number studied for this species has been further scrutinised later with reference to the other populations and found to show n=30 and 2n=60 as indicated by Panigrahi and Kammathy[7] and also in this paper. *C. maculata* Edgew, is a distinct species as now confirmed by further studies in the field and the type material. Shetty & Subramanyam[4] wrongly cited as n=c.55 for *C. maculata* due to wrong spacing in print in the abstract 1962.

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Super numbers refer to reference number.

The necessary corrections with reference to $n=c.55$ and the correct identity of the actual species growing in Sibpore (Howrah) have already been made by Kammathy and Rolla[1]. Other populations of *C. sikkimensis* as recorded in Table I further confirm the observations made by Panigrahi & Kammathy[7] as $n=45$. Morton in a private communication also indicated that his material of this species evidently obtained from India shows $2n=90$. The record of Sharma & Sharma[8] for the species collected from Rongo of the Darjeeling-Himalayas as $n=30$ and $2n=60$, therefore, needs reinvestigation. The chromosome numbers of other species from different populations as recorded in Table I confirm the majority of the earlier reports.

As already indicated by Kammathy & Rolla[1] and other earlier workers that out of 14 Indian species of *Commelina* so far worked out for chromosome numbers, 12 species indicate $n=15$ or multiples of 15 and this observation is now further confirmed by another two more species whose chromosome numbers are newly reported in this paper. Further, Lewis[24], Jones[23] etc. are also in agreement with our findings. It is interesting to record here that Morton[11] though so far recorded mostly $n=14$ for the African species in his published data, in a private communication to the authors indicates on the basis of his further work on the African species of *Commelina*, much greater difference in chromosome numbers than expected by him before and also confirms that he found $2n=22$ and 30 in some African populations of *C. benghalensis* and *C. diffusa* respectively. But, so far as the Indian species of this genus are concerned, majority of them indicate a distinct pattern with $n=15$ or its multiples.

Morphological evidence on three sections of the genus *Cyanotis* Don (*sensu lato*) shows unnatural assemblage. The chromosome numbers of the majority of the species which have been studied both from the field and under cultivation are now known. Species of *Cyanotis* (*sensu stricto* ;=*Eucyanotis* section of Clarke[3]) normally show $n=12$. The chromosome numbers of the 2 newly recorded taxa together with the new populations of other species of *Cyanotis* noted in Table I, further support the uniformity in all species of *Cyanotis* (*sensu stricto*). This is further supported by Lewis[24] who considers that most of the taxa under the genus from Africa with $n=12$. He[24,25], however records *C. vaga* (Lour.) Schult. f. (=*C. barbata* Don) of Africa as showing $n=11$; but several populations of this species from Shillong and Darjeeling (as worked out by the authors MS.) show distinctly $n=12$. Now in this connection, it is of considerable interest to add that the material (Devarayadurga, Mysore, 73320) reported by the authors[2] under *Cyanotis arachnoidea* C.B.Cl. (bulbiferous) with $n=11$, has been further worked out with type material at Kew and correctly identified as *C. arachnoidea* C.B.Cl var. *thwaitesii* (Hassk.) Rolla Rao et Kammathy[22]. This variety has also been collected from Africa and the material at Kew shows considerable variation (personal communication by Mr. J. P. M. Brenan, Kew in June, 1963 and second author's recent study at Kew in August, 1964). On the contrary, *C. vaga* has not so far been recorded from Africa. Further, smaller plants of *C. vaga* and *C. arachnoidea* var. *thwaitesii* without the underground parts, may easily be confused. It is, therefore, of primary importance to re-examine the complete specimens of '*C. vaga*' reported by Lewis[24] from Africa in relation to *C. arachnoidea* var. *thwaitessi*. *Cyanotis fasciculata* var. *glabrescens* has also been observed in the field as a good variety though not a distinct species and is common mostly along 1000-1500 metres altitude of the Western ghats. The gigantic hexaploid reported under C. *tuberosa* from Mahabaleswar by Kammathy and Rolla[2] has been found to be distinctly associated with only higher altitudes of 1000-1500 m. having high rainfall. It is easily distinguishable in the field by its habit and other characters from *C. tuberosa* (Roxb.) Schult. f. and its variety *adscendens* Cl. (diploid and tetraploid) and has so far not been collected outside the Sahyadri ranges. Blatter[12] is correct in naming this as a distinct species *C. sahyadrica*. The chromosome number of another population of this species agrees with the earlier observations (Kammathy & Rolla[2], Raghavan & Rolla[9]). More details on this species will published elsewhere.

Shetty and Subramanyam[4] report $n=8$ for *C. papilionacea* and have recorded sharp contrast in the size of the bivalents from that of other species. Such a number in *Cyanotis* (*sensu stricto*) is rather unusual. Keeping this in view, *C. burmanniana* Wt. which is considered as a variety of *C. papilionacea* by Clarke[3] has been studied and its chromosome number is found to be $n=12$ which, on the other hand, follows the usual pattern of *Cyanotis* (*sensu stricto*). Our ovservations on the habit and habitat of *C. burmanniana* which are distinct from that of *C. papilionacea* indicate that Wight[20] is correct in considering *C. burmanniana* as a distinct species. However, these two species together with their closely allied *C. vaginata* Wt. whose habit and habitat are also found to be distinct, need further study particularly with reference to the cytology for a proper assessment of their status and their affinity with other members of *Cyanotis* (*sensu stricto*).

On the basis of further evidence gathered both from the field and under cultivation (Rolla & Kammathy[15] and following the opinion expressed earlier by Sharma[5], Kammathy & Rolla[2] and further supported by Shetty & Sabramanyam[4] the two species, *Cyanotis axillaris* (Linn.) Schult. f. and *C. cucullata* (Roth) Kunth are transferred to the genus *Zygomenes* Salisb. (Rolla[22]). But it is now found that Salisbury in 1812 did not describe the genus and later, by Hasskaral's[26] citation, the genus name got validated under a different circumscription and therefore becomes a superfluous synonym to *Cyanotis* D. Don (*sensu stricto*). Hence a new name, *Amischophacelus* Rolla et Kammathy (being published elsewhere) has become necessary.

Euploidy and intra-specific polyploidy are observed in certain populations of a few species of *Murdannia*. Occurrence of $n=10$ and its multiles in different species like *M. nudiflora*, *M. dimorpha*, *M. esculenta* as reported earlier[2] and *M. hookeri* as presented now (all with $n=10$); *M. loriformis*[2], *M. spirata*, *M. vaginata* (all with $n=20$); *M. simplex* and *M. ochracea* as reported earlier [2,9] (with $n=30$); *M. simplex* (with $n=40$)[16] clearly indicate euploidy. Intra-specific polyploidy has, however, been observed only in a limited number of species such as *M. gigantea* (Vahl) Brückn. (smaller diploids from Shillong with $n=11$ and robust tetraploids from Tenmalai with $n=22$); *M. simplex* (Vahl) Brenan (similar forms from Mahableshwar with $n=30$[9,2] and Shillong with $n=40$[16]); *M. elata* (Vahl) Brückn. (Gajanoor form with $n=32$[2] and Rongo form with $n=20$[8]) and *M. semiteres* (from different parts of Western ghats including Agumbe with $n=6$ and the Hyderabad form with $n=12$[2]). On the basis of the wider evidence now available for *M. semiteres*, clearly indicating the chromosome number of Western ghat populations and also Agumbe as $n=6$, observations of Raghavan and Rolla[9] on the populations of Agumbe with $n=7$, Bhimashankar with $n=10$ and Matheran with $n=20$ all covering Western ghat region only will be reinvestigated. It is interesting that *M. semiteres* growing in a drier region like *Hyderabad* and looking similar in all respects with the Western ghat forms presents $n=12$. Closely following *M. semiteres*, an interesting collection recently made from Tenmalai and studied under cultivation and further located from other areas of South India from the different herbarium material, also presents $n=12$. However, this is a distinct species with an underground bulb and prennial in nature and is cited as follows:

Murdannia juncoides (Wt.) Rolla *et* Kammathy *comb. nov. Dichaespermum juncoides* Wt. in Ic. Pl. Ind. Or. 31, tab. 2078, 1853; *Aneilema paniculatum* Wall. ex Cl. in DC. Mon. Phan. 3:215, 1881, *pro. parte*; *Murdannia semiteres* (Dalz.) Santapau in Poona Agric. Coll. Mag. 41:284, 1951, *pro. parte.* The details of the species will be published elsewhere.

Earlier reports of the chromosome numbers together with the present observations indicate intraspecific aneuploidy in *M. wightii*[22] (Agumbe-$n=10$[9] and $n=9$ present report) and *M. spirata* (Agumbe $n=9$[9], Darjeeling $2n=20$[8]; Karjat—present report, South India[17], Khasia Hills[16], Shertallai[3]—all $n=20$). However, in view of the wider evidence now available for *M. wightii* as $n=9$ and *M. spirata* as $n=20$, it would be appropriate to reinvestigate the Agumbe and Darjeeling populations of these species.

Murdannia hookeri, which appears to be endemic to Khasia Hills of Assam, shows $n=10$ following the usual pattern in the majority of the species of the genus.

Chromosome number and their abrupt size difference as recorded by Sharma & Sharma[8] for a population from Darjeeling-Himalayas of *M. vaginata* are further confirmed from a population near Hyderabad, a place quite distant and distinct from the Darjeeling-Himalayas. However, with the present background of the genus, it may be rather premature to consider the possibility of its intergeneric origin as suggested by Sharma and Sharma[8]. Such abrupt size differences in the chromosomes have also been observed in *M. simplex* (Panigrahi and Kammathy, unpublished) and in *M. loriformis* (Hassk.) Rolla *et* Kammathy[2], Shetty and Subramanyam[4] (under *M. simplex*).

Of the five Indian species of *Pollia*, which are considered as good, three species have been studied under cultivation and the chromosome numbers determined. It is interesting to record that all the three species show uniform chromosome number as $n = 16$ as indicated in Table I and this observation is further supported by the observations of Mangenot and Mangenot[13] as $2n=32$ for the African species of *P. condensata* C.B.Cl. Darlington and Wylie[14] however, report $2n=10$ for the East Himalayan population of *P. subumbellata* whereas the population from similar area worked out at present indicates clearly $n = 16$.

On the basis of the data collected both morphological and cytological while examining the Indian species of *Pollia* in the field and under cultivation, it is considered that the genus is quite a natural one and the separation of the same by Brückner[18] into *Aclisia* E. Mey. and *Pollia* Thunb. is not appropriate.

Streptolirion volubile Edgew. *Streptolirion cordifolium* (Griff.) O. Ktz. Brückner in Pflanzenfam. 15a, 171, 1930. *Tradescantia cordifolia* Griff. Priv. Jour. 208, 1847, *nec.* Swartz Prodr. Veg. Ind. Occ. 57, 1788.

This species is restricted to the Himalayan region including N.E.F.A., Khasia and Jaintia hills of Assam in India and extends further east towards Burma and China. The Himalayan form is very smooth and glossy and the chromosome number, of this form $2n = 12$ as reported by Sharma & Sharma[8], is further confirmed in the present report. On the basis of the study of the material both from the herbarium and from the field, it is evident that the species growing in Khasia hills is a clear hairy form and such form as seen from Burma specimens is more prominently brownish hairy. Clarke's[3] consideration of this form as a variety *S. volubile* Edgew. var. *khasiana* Cl. seems to be appropriate. It is interesting to record here that the validity of such a variety is further confirmed by the aneuploid number of chromosomes of the hairy forms from Shillong as $2n=10$ and $n=5$ (Panigrahi and Kammathy—unpublished).

ACKNOWLEDGEMENTS

The authors' thanks are due to the Council of Scientific and Industrial Research for financial assistance and to Dr. H. Santapau and other colleagues for constant co-operation.

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TABLE I

RESULTS OF THE VARIOUS SPECIES OF COMMELINACEAE INVESTIGATED

Serial No.	Name of Species	Locality and Field Numbers	Present Observations	Remarks and Previous observations
*1	*Aneilema ovalifolium* (Wt.) C.B.Cl.	Garsappa (Mysore) 78719, Agumbe (Mysore) 83040	$n = 14$	
+2	*A. scaberrimum* (Bl.) Kunth (=*A. protensum* Wall. ex C.B.Cl.)	Garsappa 78698, Agumbe (Mysore) 82971, Anamalais 73948, Tenmalai (Kerala) 77195, Nongpoh (K. and J. Hills, Assam) 81214.	$n = 29$	$n =$ c. 59^{21}
3	*Commelina diffusa* Burm. f.	Malwan (Maharashtra) 78487	$n = 15$	$2n = 28^{8,11}, 30^{1,5,9,10}\ 56^{8,14}$ $n = 15^{24,25}$
4	*C. hasskarli* C.B.Cl.	Purandhar (near Poona) 32612	$n = 45$	$n = 45^{9}$
*5	*C. indehiscens* Barnes	Basavanguda (near Beduguli, Mysore) 73768, Anamalais 73947.	$n = 75$	
6	*C. kurzii* C.B.Cl.†	Kallar (near Coimbatore) 73928	$n = 45$	$n = 45^{1}, 60^{1}$
+7	*C. longifolia* Lam. (= *C. salicifolia* Roxb.)	Samalkot (Andhra) 32787	$n = 45$	$2n = 75^{5}$
8	*C. paleata* Hassk.	Igatpuri ghat (Maharashtra) 81378, Karjat (near Poona) 81576	$n = 45$	$n = 45^{1}$
9	*C. paludosa* Bl.	Kalimpong (W. Bengal) 81257	$n = 30$	$2n = 45^{8}, 60^{1,7,8,19}$
10	*C. maculata* Edgew. (=*C. paludosa* Bl. var. *viscida* (C.B. Cl.) Rolla *et* Kammathy)	Darjeeling 81241	$n = 30$	$n = 30^{7}$
11	*C. sikkimensis* C.B.Cl.	Cherrapunji 81208, Darjeeling 81242	$n = 45$	$n = 45^{7,19}, 2n = 60^{8}$
12	*C. suffruticosa* Bl.	Rangeet (near Tista, West Bengal) 81263	$n = 30$	$n = 30^{1,7,19}$,
13	*C. ensifolia* R. Br. (=*C. undulata* Cl. non R. Br. var. *setosa* C.B.Cl.) ††	Kallar (near Coimbatore) 73932	$n = 45$	$n = 45^{1}$
*14	*Commelina kotschyi* Hassk. (Species-new record for India)	Near Bibi village (Khed Taluka, Maharashtra) 81650	$n = 15$	
*15	*Cyanotis burmanniana* Wt.	Shertallai (Kerala) 82601	$n = 12$	
16	*C. fasciculata* (Heyne *ex* Roth) Schult. f. var. *fasciculata*	Katraj ghat (near Poona) 32889 Igatpuri (Maharashtra) 81338	$n = 12$	$n = 12^{4,9}$
*17	*C. fasciculata* (Heyne *ex* Roth) Schult. f. var. *glabrescens* C.B.Cl.	Panchgani (Maharashtra) 32824	$n = 12$	
18	*C. sahyadrica* Blatter	Igatpuri (Maharashtra) 81396	$n = 36$	$n = 36^{2,9}$ (under *C. tuberosa*)
19	*C. vaga* (Lour.) Schult. f. (= *C. barbata* Don)	Darjeeling 81250	$n = 12$	$2n = 24^{8}$
*20	*Cyanotis cerifolia* Rolla et Kammathy (Sp. described elsewhere)	Anamalais 73950 ..	$n = 12$	
*21	*Murdannia hookeri* (C.B.Cl.) Brückn.	Mawphlong (K. & J. Hills, Assam) 81296	$n = 10$	
*22	*M. juncoides* (Wt.) Rolla *et* Kammathy (=*Dichaespermum juncoides* Wt.)	Tenmalai (Kerala) 77404	$n = 12$	
+23	*M. wightii* Rolla et Kammathy [=*M. pauciflora* (Wt.) Brückn.]	Agumbe (Mysore) 82727, Shertallai (Kerala) 82602	$n = 9$	$n = 10^{9}$
+24	*M. semiteres* (Dalz.) Santapau	Maharashtra : Igatpuri 81392 Shahapur 81481, 81509 Kalyan 81324 Karjat 81573 Mysore : Kavaledurga (near Agumbe) 82915	$n = 6$	$n = 7^{9}, 10^{9}, 20^{9}, 12^{2}$
25	*M. spirata* (L.) Brückn.	Karjat (near Poona) 81536	$n = 20$	$2n = 40^{8,18,17}, n = 9^{9}, 2n = 20^{8}$
26	*M. vaginata* (L.) Brückn.	Alisagar (near Hyderabad) 81287	$n = 20$	$2n = 40^{8}$
*27	*Pollia hasskarlii* Rolla (= *P. aclisia* Hassk.)	Nongpoh (K. & J. Hills, Assam) 81235	$n = 16$	
*28	*P. secundiflora* (Bl.) Backer (=*P. sorzogonensis* (Miq.) Mey.	Garsappa (Mysore) 78703, Hulical (Mysore) 81154	$n = 16$	
*29	*P. subumbellata* C.B.Cl.	Rangeet, near Tista (West Bengal) 81266	$n = 16$	$2n = 10^{14}$
30	*Streptolirion volubile* Edgew.	Darjeeling 81239	$n = 6$	$2n = 12^{8}$

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* Chromosome number reported for the first time.
+ Chromosome number differs from previous reports.
† Capsule with an indehiscent, posterior cell.
†† Capsule 3-equal celled.

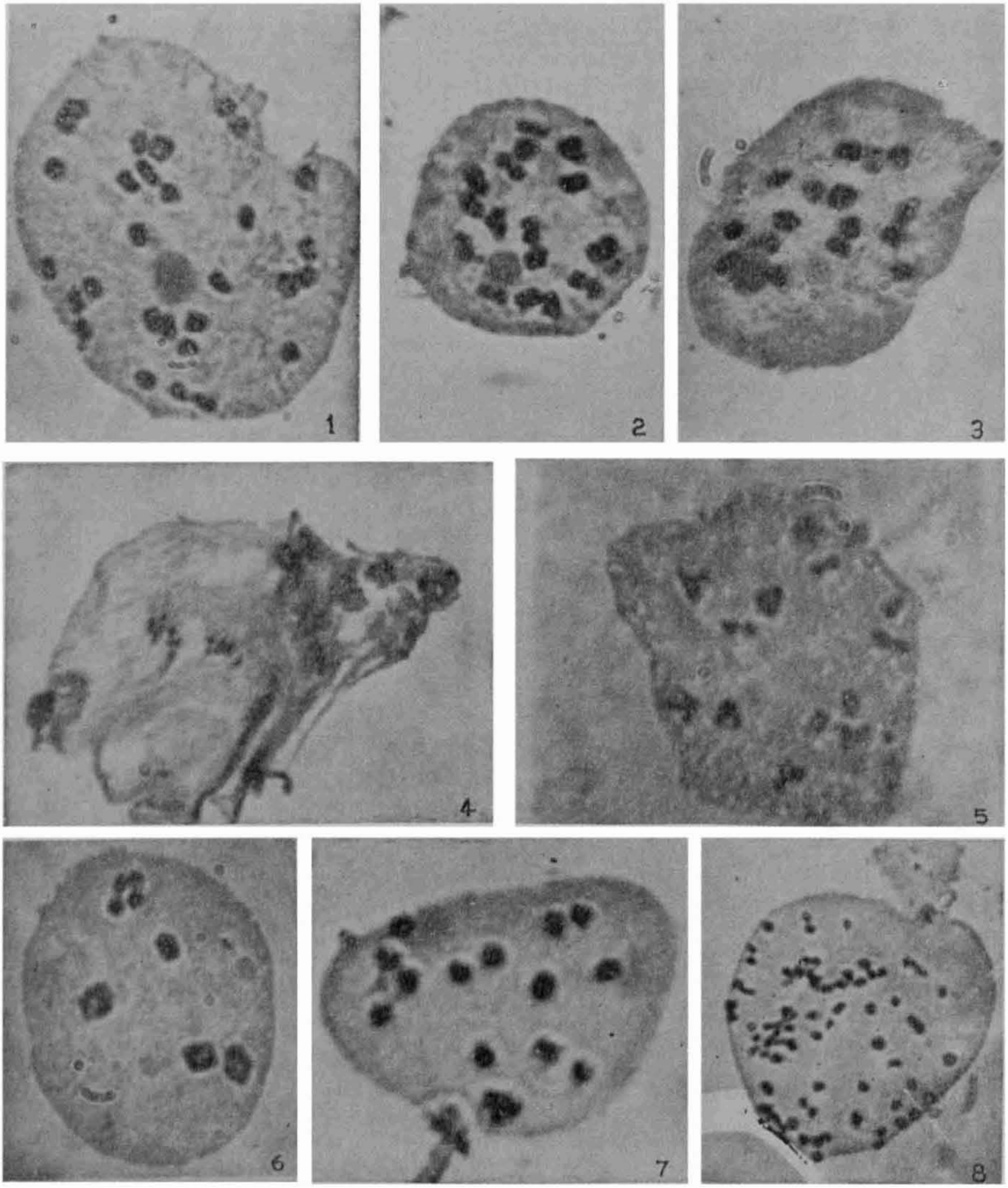

PLATE 1

Figs. 1—8. 1. *Aneilema scaberrimum* n = 29 (×c. 1125) ; 2. *Pollia subumbellata* n = 16 ; 3. *P. secundiflora* n = 16 (×c. 1500) ; 4. *Murdannia wightii* n = 9 (×c. 600) ; 5. *M. juncoids* n = 12 (×c. 1500) ; 6. *M. semiteres* n = 6 (×c. 1400) ; 7. *Commelina kotschyi* n = 15 (×c. 1500) ; 8. *C. indehiscens* n = 75 (×c. 600).